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And then came Complex Project Management

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Abstract—The subject of management is renowned for its addiction to fads and fashions. Project Management is no exception. The issue of interest for this paper is the establishment of the 'College of Complex Project Managers' and their 'competency standard for complex project managers.' Both have generated significant interest in the Project Management community, and like any other human endeavour they should be subject to critical evaluation. The results of this evaluation show significant flaws in the definition of complex in this case, the process by which the College and its standard have emerged, and the content of the standard. However, there is a significant case for a portfolio of research that extends the existing bodies of knowledge into large-scale complicated (or major) projects that would be owned by the relevant practitioner communities, rather than focused on one organization. Research questions are proposed that would commence this stream of activity towards an intelligent synthesis of what is required to manage in both complicated and truly complex environments.

1. INTRODUCTION

FADS and fashions in management are well understood phenomena [1]. Project Management (PM) could itself be described as 'currently fashionable', given the level of interest in the area. On the one hand, PM is recognized to be the key enabler of business change and a vital contributor to future business success [2]. On the other, projects commonly fail to meet their objectives [3-5]. What are project managers and their organizations to do to resolve this dissonance? Unfortunately, one method is to grasp at any credibly sounding notion [6], the latest one being entitled 'complex project management,' as promoted by the College of Complex Project Managers (CCPM).

This new phenomenon has emerged and appears to have gained momentum unchecked by any critical debate. The CCPM has produced its own competency standard (Competency Standards for Complex Project Managers (CSCPM)) which holds little back on its claims. "This standard lays the foundation for project management to effectively deal with complex projects, and in doing so, to add real value to our world." [7]

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The objective of this paper is to examine this phenomenon and the associated claims, and to provide a development of the critical debate concerning the utility of the phenomenon and its implications for the practice of PM. The outcome is a set of recommendations for how the debate can be progressed through grounded research.

The paper is structured around three main issues. The first concerns the nature of complex and complexity being discussed. The approach used by the College and the standard are compared with existing approaches. Secondly, the process by which the College and standard has emerged is examined. Lastly, the content of the standard and its implications are discussed.

2. THE NATURE OF COMPLEXITY AND THE COMPLEX PROJECT MANAGER

> *"Every decade or so, a grandiose theory comes along, bearing similar aspirations and often brandishing an ominous-sounding C-name. In the 1960 it was cybernetics. In the '70s it was catastrophe theory. Then came chaos theory in the '80s and complexity theory in the '90s"* [8].

Project managers have a wide and diverse set of applications for the term 'complex' [9], without drawing distinctions between complex and complicated, for instance. Some unpacking of the term is useful however, to allow more specific examination of relevant aspects of complexity theory.

Complexity theory has been liberally applied over the last decade in many disciplines as disparate as astronomy, biology, physics and finance in an attempt to solve complex problems [10]. Much theory building and modelling of complex systems has taken place from which we may make successful predictions about the real world, but very few practical tools have been developed to manage or control complex systems. Traditional methods are often the only option humans have to muster some sort of control of complex systems, and these predominate in the PM literature [11].

The science of complexity is about the study of systems whose behaviours and properties primarily arise from the *interactions* between their individual elements rather than the elements themselves [12]. As Maylor & Vidgen [9] have described, this

is only one aspect of project complexity. Complexity in the project environment comes not only from individual structural elements (categorised as being external stakeholders, project characteristics and organisational complexity) and their interaction, but also from the dynamic effects of each of these changing and then interacting as they change, causing further change in other parts of the system. Maylor & Vidgen's model of complexity is shown in Fig. 1.

	Independent	Interacting
Structural	1. Independent structural complexity	2. Interacting structural complexity
Dynamic	3. Independent dynamic complexity	4. Interacting dynamic complexity

Fig1: Structural Dynamic Interaction (SDI) Matrix

Outside of the project world, examples of complex systems include governments, families, the human body (physiological), a person (psychosocial), the brain, the ecosystem of the world and sub-world ecosystems: desert, rainforest, ocean, and forest fires, traffic jams, the spread of infectious disease, and the weather [12, 13].

So what does complex mean in PM? Common synonyms for the term complex are; complexity, complicated, intricate, involved, tangled, and knotty, to name but a few. Commonly the PM literature uses the term loosely when describing the "web of relationships" among project stakeholders that needs to be managed (e.g. [14]). Projects themselves have been described as complex systems that require management [7, 15], not only because they deal with technological issues but because they deal with the wider organizational factors largely beyond the project manager's control [16]. Using the above matrix, we can say that they are truly complex where they exist in stage 4 of the SDI matrix – they have multiple structural elements interacting and changing as they progress. This precludes many projects, including very large ones, where they may have very high levels of structural complexity, but due to stability in other conditions, do not have the dynamic interaction complexity. A question that arises from this discussion is the metric that would apply to a project to put it into the complex (stage 4) category. This has not currently been established and is required to provide some threshold to the inevitable notion that most projects possess some degree of complexity. Thus complexity is a variable rather than a binary commodity, and without measures for it, is a term that is less than helpful, particularly when being used to prescribe what is and is not a complex project.

In addition to this, it is notable that projects are socially constructed entities [17, 18], and so can be described as complex adaptive systems. Indeed, there are many notions of complexity, describing projects in terms of complexity landscapes, for instance.

2.1 A case of mistaken identity

With the above in mind, we now consider the approach taken to complexity by the College and the standard.

Section 3 of the CSCPM [7] defines the characteristics of complex projects. It uses the language of complexity science such as open, dynamic, recursive, non-linear feedback, and emergent, however these are not the characteristics of the projects cited in the definition. A game of chess is used to exemplify dynamic complexity where parts of the system can react and interact. However, chess is a two player, time and turn based game, with a clear set of deterministic rules. The system is not open. It is played on a square board of eight rows and eight columns, and each player begins with an identical set of sixteen pieces; king, queen, two rooks, and so on. Extra squares never emerge, and when two pawns are next to each other they do not turn into a jester with a whole new set of movement rules. Each player's move ultimately focuses on capturing their opponent's king. Each chess piece has a well defined set of rules concerning how it moves and how it can capture other pieces. The movements of each piece cannot be described as dynamic or emergent. Consider the king, a piece that can only move one square any which way at a time. Once in every game the king is allowed a special move known as castling. The novice or non-player might describe the king's behaviour as complex, but those well versed in the game of chess consider the behaviour knowable – complicated (when or where in time castling occurs) maybe, but still predictable because only a limited number of moves are technically possible. The behaviour is still not non-linear or emergent when a player's pawn advances to its eighth rank and gets promoted to a queen, rook, or knight of the same colour (almost always to a queen) because this behaviour is still deterministic – it is causally determined by an unbroken chain of prior moves.

Simply having unforeseen events that occurred during daily project work activities is not evidence of a complex system. Unforeseen events are inevitable to some degree in almost all projects. Therefore without defining the level and the challenges of complexity, it is unsupportable to claim that "a completely new way of managing is required to control these unforeseen events". Uncertainty is a fundamental characteristic of all projects, as most introductory texts will testify. High levels of uncertainty may indicate a dynamically complex project, but this does not provide an exclusive definition – many small and relatively simple projects could be classified as complex by this definition, and indeed there are well developed responses to these situations, as we will show. Testing the definition further, the CSCPM [7] cites the résumés of the Fellows of the College of CPM. If one considers the

projects the Fellows have managed e.g. gas and oil pipelines, railroads, flight control centres, space shuttle engines, combat ships, missile software, civil engineering and offshore structures to name a few, one immediately sees that these systems are not necessarily complex. Complicated though they may be, if all of their parts are inert, they are not complex. Their behaviour as a whole may be entirely understood by reducing them to their parts. Morris and Hough [19] categorised these as *Major Projects*, as does the UK's Major Projects Association (see [20]).

The types of projects referred to in the CSCPM may not meet a threshold measure of complexity, but the social environment in which they take place may do. The Fellows of the College have therefore managed complicated projects in complex social environments – but as for dealing with uncertainty, this is the case for the majority of PM practitioners.

2.2 The complex project manager

The standard hypothesises that today, (more than in previous times) there exists a special category of projects called complex projects, the proper management of which can only be achieved by persons who are appropriately certified and sanctioned by their peers.

The CSCPM [7] suggests there is a global acceptance of the shortfall in supply of complex project managers. Moreover, that there is an increasing demand for complex project managers. This is stated without a definition of complex (as stated above) or any data to justify that there is indeed an increase in the demand.

Clearly, many activities we participate in are very complicated; they have many components, many interactions, have well defined boundaries with predictable interactions across them. Some activities are complex – we can at least qualitatively say this. There is an inherent limitation in our ability to predict the long-term or emergent behaviour they create. It is not that prediction is merely hard or that the system has not been completely modelled or understood. Rather, the lack of predictability arises from the nature of the interactions between the components and often from the inability to measure the state of the system at any time with sufficient precision.

2.3 Managing under Complexity

Just because we know a system is complex does not mean that we require complex tools to control or manage it. More traditional methods may continue to be appropriate because we live on a scale where these methods work well. The human brain has evolved to help us survive in a world where objects are neither very small nor very large and where things stand still or move slowly. Today it is commonly agreed that Quantum Mechanics describes how the world really works. However, humans have evolved in a world where Newtonian physics works well enough because simple laws emerge on the scale our bodies operate. There are challenges to many of the long held beliefs about tools and techniques used in projects, but these apply across the board and are not necessarily limited to something that may be labelled as complex. Critical Path Method, for instance, is a useful part of project planning, but it does not model the reality of the uncertainty of the project environment well in either small or large projects, simple or complicated [21].

Clearly here too, there is an opportunity for the issue to be considered further. Before continuing with the notion that because a project is complex we need new tools and techniques, it would be helpful to have a picture of what constitutes use and effective use of the existing tools and techniques, and how they work in environments of varying dynamism.

In addition to tools and techniques, how does one manage or attempt to control a truly complex system? What kind of interventions are useful, and which interventions simply exacerbate problems [22]? The weather is a complex system. The term 'weather' usually refers to the activity of atmospheric phenomena over short periods of time such as hours or days. Weather forecasts are made by collecting data on the current state of the atmosphere (temperature, wind, humidity etc) and then using computer models to determine how the atmosphere is expected to change. The complex nature of the atmosphere means that perfect forecasting is impossible, and forecasts become less accurate as the forecast range increases. The methodology of forecasting the weather can be similarly applied to other complex systems like the stock-markets. Again, perfect forecasting is impossible and only short range forecasts are reliable. The 50% rule and rolling wave planning (e.g. [23]), Last Planner [24], and variations on agile project management [25], extreme programming and other IT-derived methods, are all responses to this reality. None of these are factored into the discussions of dealing with this claimed new complexity.

Having set out current understanding of complexity, the approach taken by the College can be assessed as having not justified that the projects in which they are interested are complex, because they have not satisfactorily established any measures or threshold for such complexity. Indeed, the projects listed in the resumes, whilst 'large' or 'major' projects, are hardly unique. Similarly, stating that they are socially constructed systems is a useful view, but again does not provide any meaningful exclusivity. The additional demand for 'complex project managers' is not justified. Finally, the requirement for new tools and techniques is not based on any critical evaluation of either the espoused theory or the theory in practice. Relatively recent responses in the literature have not been evaluated.

3. THE PROCESS BY WHICH THE COLLEGE AND THE STANDARD HAS EMERGED

In 2006 PM was purportedly added to the list of disciplines to which complexity theory was applied, as the 'discipline of

CPM' was unofficially launched at the 20th IPMA World Congress in Shanghai. As discussed previously, the application of complexity theory to PM was not new even then, being pre-dated by Shenhar [15] and others [26, 27].

It is clear though, that there are some well established responses to complexity – as outlined above. In developing a future research agenda for PM, the Rethinking Project Management Network (2004-2006 – see [28]) attempted to move the agenda of research away from the highly deterministic view of projects that had prevailed up to that point.

However, approaches away from the mainstream (as defined by the bodies of knowledge for instance) are not well developed, and will require further investigation before they can be regarded as 'current technology.' The following section considers the content in more detail, but for now the process by which the College and standard have emerged is worth stating.

During 2006 there were extensive efforts on the part of the protagonists of the College to recruit senior practitioners as Fellows of the College. In doing so, this provided implicit endorsement of the College, its aims, and the processes of the organisations that the Fellows represented. This process by itself has succeeded where the other PM institutions have only had limited success restricting entry to the profession (see e.g. [29]).

One also has to question the basis that the Fellows are working from. Specifically, given the levels of performance indicated in survey after survey (e.g. [30]), is promoting the existing incumbents really a good idea? This appears to be running the risk that the existing approaches, which can hardly be said to be working effectively, are simply reinforced and further legitimised and institutionalised. Further, what is the problem that this initiative is trying to solve or be part of the solution to? By what analysis is the addition of further competencies to individual project managers, the solution to 'challenged performance' in (military) major projects? A fuller analysis of the issues (as we will propose) may for instance, find that the issues are more systemic rather than under the influence of the project manager. Issues such as the ownership and management of risk and opportunities (rather than outsourcing risk) may be at the root of the problems faced. Without fuller analysis we can only speculate on this. Intuitively, the supply of complex project managers is unlikely be at the root of such analysis. Any credible business case for change must consider root causes.

What is the likely business case for the standard? Section 11 of the CSCPM describes the College as a charity as it is not for profit and has no membership fees (Australian and UK Defence Departments are currently providing secretarial support). However, it also mentions that the College will develop and establish postgraduate programmes in CPM. Section 12 provides a glimpse at what the CSCPM and College is likely to be all about – not only selectively awarding the keys to the profession, but owning the gates to it. One consequence of the Australian and UK Defence Departments willingness to sign up to the CSCPM, is that all government contractors and subcontractors will necessarily be required (it will not be optional) to train and certify their project managers in CPM. This need for training and certification will powerfully drive a whole new industry of CPM course developers, trainers, and certifiers. Given the size of the industries involved, this has the potential to be a substantial business, though this does depend on how far down the work breakdown (assuming the WBS concept is still relevant in complex projects, it being so reductionist in outlook) the complexity would be perceived to go.

It is clear that the Fellows of the College decide who they let in to their club; they choose who they give the keys to. The College, the administrators of the standards and therefore the keepers of the gates to 'the profession' can, in the same manner that they created it, change it at will. Amongst the questions this situation poses is how useful is this situation to the Australian or UK Defence Departments?

The situation is clear. The development of the College and its standard has proceeded without checkpoints and with political support rather than intellectual input to test the core concepts. We will discuss the content of the CSCPM in the following section; however, based on the argument thus far there is the potential for an entire new industry in training and certification to add to the current melee in this area. The business case for this is not clear, and neither is the level of control that the College will exert in the future over the content of its standard.

4. THE CONTENT OF THE COMPETENCY STANDARD

Notwithstanding the challenges identified above – the definition and the process both being flawed, the content should similarly be treated in a critical manner. When the APM was revising its BoK (see Morris [31]), there was a significant research project underpinning it. When PMI undertake revising their BoK, they draw on the extensive research that they commission to do this. Whatever the politics or purpose of those standards, they have at least some basis to the claim of representing 'accepted practice' (though not best practice). The attempt at normalisation is justified on the basis that there are many organisations who have not even got to a basic level of process, and many new project managers coming into 'the profession' daily who need to have a grounding in these basics.

However, none of these are based on such a limited view as the standard being promoted by the College. It is not clear what research has underpinned its development, and the competence levels appear to have been allocated on an entirely arbitrary basis as any attempt to rationalise the allocation of competency levels in the example shown in fig. 2 will show. Fig 3 provides a key to the four levels of competency. We think it perfectly reasonable for the authors of the CSCPM to demonstrate the

empirical evidence for the practices that will be driven and enforced through the standards.

View 3: **Change and Journey**

ELEMENT 3.10: **Pilot projects - symbolism and the management of meaning**

Action in Workplace

		Traditional			Complex	
		Project Manager	Snr Project Manager	Program Manager	Member	Fellow
3.10.1	Uses the creation of myths as a key tool in cultural change	D	D	P	C	L
3.10.2	Uses pilot projects to link project values to outcomes to create new symbols of behaviour	D	D	P	C	L
3.10.3	Provides visible leadership that "walks the talk". Sets high performance standards for self, acting as a role model for the team	P	P	C	C	L
3.10.4	Searches out opportunities that link project values to outcomes to create new symbols of behaviour	D	D	P	C	L
3.10.5	Uses both positive and negative symbolism	D	D	P	C	L
3.10.6	Does not allowing Machiavellian behaviour. Deals with individuals who breach values in a way that satisfies national values	D	D	P	C	L
3.10.7	Uses first level supervision as the primary source of communication	P	P	P	C	C

Evidence Guide:

Generic - Supporting evidence may include:

- Communication process deliberately creates symbols and myths
- Management of meaning expressly dealt with in meetings

Fig 2: Example of a CSCPM competency view

D *(Development)* - The project manager applies the competency under direct supervision.

P *(Practitioner)* - The project manager applies the competency without the need for direct supervision, but within the bounds of standardised processes, procedures and systems.

C *(Competent)* - The project manager applies the competency without the need for direct supervision, provides direct supervision of the competency for others, and mentors development of the competency in others.

L *(Leader)* - The project manager provides professional leadership in the competency. They lead in the design of processes, procedures and systems, and have the ability to use the competency flexibly and creatively.

Fig 3: Four levels used in classifying actions in workplace

Having seen the criteria, consider how a certifier of the standard would validate evidence in order to certify a CPM practitioner as competent or even leader. Concerning examples are not hard to find in the CSCPM. Fig 2 shows View 3 Change and Journey, element 3.10 Pilot projects – symbolism and the management of meaning: certifiers are required to validate evidence that the practitioner is competent in myth creation and 'walks their talk''. Another example, View 10 Special Attributes, element 10.1 Wisdom: practitioners have a robust self-esteem, a sense of wonder, and reserves time to sit back, relax, and mull over issues.

Finally, the content itself is completely untested. One view is that it risks plunging the PM community into the dark ages. With no empirical evidence to support it, the CSCPM drives project managers to apply the knowledge and theories of metaphors, rich pictures, anti-positivism, punctuated equilibrium, and the butterfly effect. These terms have more in common with the chapter headings of a compendium on post-modernism than they do with real people managing (complicated) projects. Whilst they provide useful views of the project environment, they are relatively undeveloped in application in the project environment (rich pictures in soft-systems methods being the possible exception). It would be interesting to hear the application, beyond the complexity response already discussed above (rolling wave plans, 50% rule etc), that the butterfly effect would suggest. As for previous issues, there is a real opportunity here for research to demonstrate how these ideas have been applied and their relative costs and benefits. Similarly, cases of the application of particular practices do need to be written and disseminated to support evidence-based training where skills gaps are identified.

5. CONCLUSIONS AND AREAS FOR FURTHER RESEARCH

The College and the standard trouble us for a host of reasons: the definition of complex does not stand up to any scrutiny; there has been no analysis of the problems that the establishment of this initiative is intended to solve; the process by which the College and the standard have progressed has gone un-checked; and the standard is not established on evidence based practices.

A good place to start is with an understanding of the problems faced in the kinds of projects embraced by the College – projects that we have termed 'major' rather than complex. Specifically, it is required to understand the root causes of problems. We propose the following research question:

> *What has been the root causes of failure in major (defence procurement) projects?*

This question does not assume that the causes are all generalisable, but would provide the foundation for determining the nature of the initiatives that would start towards improved performance. The role that further training and accreditation would play in this would then be evident, and the business case clear.

On the definition, we concluded that there was no case for treating the kind of projects discussed by the College as 'complex' any differently from other large, complicated undertakings. This led to the second research question:

How do you measure complexity in a robust manner, that takes account of structural, dynamic and interaction elements?

This would allow setting boundaries for levels of complexity within projects, and allow analysis of the supposition that projects have increased in complexity. Similarly, we concluded that beyond the existing tool sets of PM, there was little defined that would be relevant as tools coming from the 'post-modernist book chapter headings'. Understanding the level of complexity in a project would allow evaluation of the current toolsets, and the conditions under which these and emergent tools are effective. This led to the third and fourth research questions:

Under what conditions of complexity are the current toolsets effective?

What is in the expanded toolset for complex projects that is not in the standard set?

Related to the toolsets was the issue of the interventions that project managers can make in complex systems. These are poorly described by the standard, and are worth further research. Specifically research question five:

Under what conditions (including complex) are different interventions effective?

Finally, having started the process to provide credible knowledge under-pinning the definition and associated approaches, it would then be worth considering the personal skills, competencies, thinking processes, attitudes and abilities that underpin high performance in 'complex projects.' It has been argued that 21st century practitioner development will focus more on enabling reflective practitioners rather than providing skilled technicians [28]. A standard may indeed contain some of these elements, but it is key to such a process that we understand:

What are the characteristics of managers who appear to be able to handle complexity at pre-defined levels, and are these characteristics imitable?

We would then have some reassurance that a competency standard had some basis in fact, and was able to demonstrate business benefit to organisations that adopted it.

The process of the development of the College and the standard are undoubtedly flawed, and maybe given the emergent state of development of the academic subject area, they have simply filled a vacuum. The challenge for the academic and practitioner communities is to possess a credible suite of tools and techniques, well developed through research such as that outlined above, which are based on good evidence and that support practitioners in improving performance in their own environments.

REFERENCES

1. Abrahamson, E., *Management fashion.* Academy of Management Review, 1996. **21**(1): p. 254-285.
2. PIPC. *Global Project Management Survey*. 2005 [cited Feb 2007]; Available from: http://www.pmportal.co.uk/uploads/documents/PIPC Survey.pdf.
3. KPMG. *KPMG's International 2002-2003 Programme Management Survey*. 2003 [cited April 2005]; Available from: http://www.kpmg.com.au/Portals/0/irmprm_pm-survey2003.pdf.
4. The Standish Group. *Extreme Chaos*. 2001 [cited February 2005]; Available from: http://standishgroup.com/sample_research/PDFpages/extreme_chaos.pdf.
5. Holmes, A., *Failsafe IS Project Delivery*. 2001, Aldershot: Gower.
6. Festinger, L., *A Theory of Cognitive Dissonance*. 1957, Stanford, CA: Stanford University Press.
7. Dombkins, D.H., *Competency Standard for Complex Project Managers*, D.o. Defence, Editor. 2006, Commonwealth of Australia.
8. Strogatz, S., *Sync: The Emerging Science of Spontaneous Order*. 2003, New York: Hyperion Books.
9. Maylor, H. and R. Vidgen, *Complexity in Project-based operations: a grounded model and its implications for theory and practice.* (unpublished).
10. Ziemelis, K., *Complex systems.* Nature, 2001. **410**(241).
11. Hodgson, D. and S. Cicmil, eds. *Making projects critical*. 2006, Palgrave Macmillan: New York.
12. Bar-Yam, Y., *Dynamics of Complex Systems: Studies in Nonlinearity*. 2003: Westview Press.
13. Bak, P., *How nature works : the science of self-organized criticality*. 1997, Oxford: Oxford University Press.
14. Ng, A. and M. Loosemore, *Risk allocation in the private provision of public infrastructure.* International Journal of Project Management, 2007. **25**(1): p. 66-76.
15. Shenhar, A., *One Size Does Not Fit All Projects: exploring classical contingency domains.* Management Science, 2001. **47**(3): p. 394-414.
16. Xia, W. and G. Lee, *Grasping the Complexity of IS Development Projects.* Communications of the ACM, 2004. **47**(5): p. 69-74.
17. Whitty, S.J., *A Memetic Paradigm of Project Management.* International Journal of Project Management, 2005. **23**(8): p. 575-583.

18. Cicmil, S., et al., *Rethinking Project Management: Researching the actuality of projects*. International Journal of Project Management, 2006. **24**(8): p. 675-686.
19. Morris, P.W.G. and G.H. Hough, *The Anatomy of Major Projects: A Study of the Reality of Project Management*. 1988, New York: John Wiley & Sons.
20. Major Projects Association. *The Major Projects Association*. 1980 [cited Feb 2007]; Available from: http://www.majorprojects.org/.
21. Rand, G.K., *Critical chain: the theory of constraints applied to project management.* International Journal of Project Management, 2000. **18**(3): p. 173-177.
22. Eden, C., et al., *The role of feedback dynamics in disruption and delay on the nature of disruption and delay (D&D) in major projects.* Journal of the Operational Research Society, 2000. **51**(3): p. 291-300.
23. Maylor, H., *Project Management*. 4th ed. 2007, London: FT Prentice Hall.
24. Ballard, G. *The Last Planner*. 1994 [cited; Available from: http://www.leanconstruction.org/pdf/LastPlanner.pdf.
25. Highsmith, J., *Agile Project Management: Creating Innovative Products*. 2004, Boston,MA: Addison-Wesley Professional.
26. Stacey, R.D., *Managing the Unknowable: Strategic Boundaries Between Order and Chaos in Organizations*. 1992: Jossey-Bass.
27. Stacey, R.D., *The Science of Complexity: An Alternative Perspective for Strategic Change Processes.* Strategic Management Journal, 1995. **16**(6): p. 477-495.
28. Winter, M., et al., *Directions for future research in project management: The main findings of a UK government-funded research network.* International Journal of Project Management, 2006. **24**(8): p. 638-649.
29. Crawford, L., et al., *Practitioner development: From trained technicians to reflective practitioners* International Journal of Project Management, 2006. **24**(8): p. 722-733.
30. Bourn, J., *Ministry of Defence: Major Projects Report 2006*. 2006, National Audit Office. p. 34.
31. Morris, P.W.G., et al., *Exploring the role of formal bodies of knowledge in defining a profession: the case of project management* International Journal of Project Management, 2006. **24**(8): p. 710-721.